

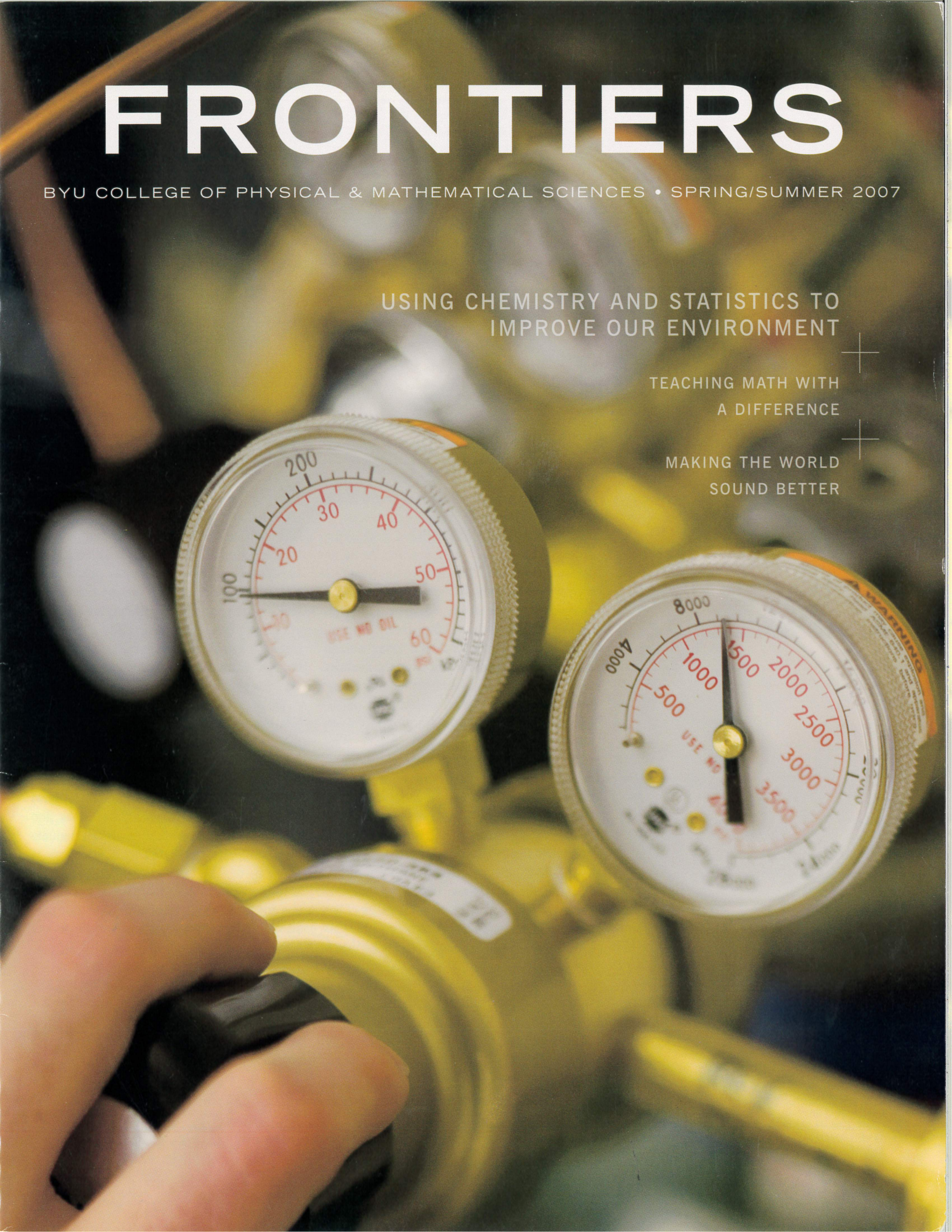
FRONTIERS

BYU COLLEGE OF PHYSICAL & MATHEMATICAL SCIENCES • SPRING/SUMMER 2007

USING CHEMISTRY AND STATISTICS TO
IMPROVE OUR ENVIRONMENT

TEACHING MATH WITH
A DIFFERENCE

MAKING THE WORLD
SOUND BETTER



DEAN'S MESSAGE



THIS ISSUE OF *FRONTIERS* IS THE LAST ONE THAT WILL CARRY A DEAN'S MESSAGE FROM THIS DEAN, AND THAT MAKES IT TEMPTING TO REMINISCE. A 37-year career on the faculty of the Department of Chemistry and Biochemistry at Brigham Young University, with the last eight years as dean of the College of Physical and Mathematical Sciences, provides a lot of memories. Fortunately, most of them are good.

My memories of BYU do not begin with a faculty career but with experiences as an undergraduate. As much as any influence that shaped my future was the opportunity to do research with two faculty members, Eliot Butler and Keith Anderson. Back then we didn't have a formal name for it, but today we call it undergraduate mentoring. Frankly, because the College of Physical and Mathematical Sciences has a long history of involving undergraduate students in significant research, we have been at the forefront of the university-wide initiative on undergraduate mentoring. It is a concept that is catching on around the country, and for us it is a very real part of the undergraduate educational experience.

The college held its 21st Annual Spring Research Conference on March 17, 2007. Over 330 students presented research results. Of those, 54 percent were undergraduate students involved in projects with members of the faculty. As we've pointed out before in *Frontiers*, these are not "canned" projects for which

the faculty member already knows the answers but real-world research problems for which answers are being sought. What could be more energizing for an undergrad than being part of scientific discovery?

How do we do it? Apart from fine students, a well-prepared and dedicated faculty, and good facilities, it takes money—mostly salaries that allow the students to pursue their mentored research rather than work at a fast food restaurant. A large share of that funding comes from you, our alumni and friends, and we and the students who work on the research are profoundly grateful. We have not yet reached the ability to provide a mentored research experience for every undergraduate student who wants one, but we are closer than we have ever been.

Within a few weeks a new dean will move into my office, and my wife—whom I met in that undergraduate research lab in 1965—and I will submit our missionary applications. We will carry away good memories of BYU and this college, and many of them will be about good students. New leadership brings new ideas, and time brings new opportunities. Undergraduate mentoring will continue to play a central role in preparing our students to make valuable contributions to the world. I am confident that alumni and friends of this college will make that possible through their ongoing encouragement and also with their generous donations.

—Earl M. Woolley

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FRONTIERS

SPRING/SUMMER 2007



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The Sound of Silence

Acoustics at BYU

DON'T BE SURPRISED IF BRIAN THORNOCK SEEMS SKEPTICAL WHEN SOMEONE BRAGS ABOUT HAVING "THE BEST SEAT IN THE HOUSE." The senior from Grandview, Washington, knows just how hard that claim is to prove. "In architectural acoustics," he says, "it's common to take measurements in a room at just a few locations, even if the room seats thousands of people." As an applied physics major with an emphasis in acoustics, Thornock has discovered the problem with this method. Although it saves time initially, since analyzers can take only one measurement at a time, it can't explain how sound really behaves in a room. That means your front-row seat might not be so hot when it comes to actually hearing the performance. And that's not an easy glitch to fix. As it turns out, a lot might be happening between these few locations that measurement processes just can't pick up. Until now, that is.

Thornock explains, "With the advent of new software-based analyzers that are capable of making over 30 measurements at a time, taking measurements from every seat in a room is much more feasible." In his last semester at BYU, he is working on designing and developing circuits that will convert the power the mul-

tichannel units supply into the power that the new precision equipment requires. In addition to faculty mentoring, BYU offers something else that's made his work possible: a room that eliminates echo, allowing Thornock to understand the properties of a sound source in a space that's as dead as possible. "The anechoic chamber has played a key role in testing these circuits so that we know exactly what role the circuit plays in the signals we receive," he says. "This reveals any design flaws that might be present, flaws we wouldn't be able to identify in a regular room."

The anechoic chamber has set BYU's acoustics program apart from others around the nation. Physics and Astronomy Department chair Scott Sommerfeldt appreciates the value the anechoic chamber adds to BYU's program. "We certainly have the best facility in the state," he says, "and there are few places—certainly not university settings—that would rival us."

But after 50 years of constant use, the anechoic chamber was beginning to show signs of wear and tear. "It was working really well for us; it was just getting old," says Sommerfeldt. "Some of the wedges were deteriorating a little bit, we had some electrical problems, some of the outlets needed to be fixed—it was time to

"We certainly have the best facility in the state, and there are few places—certainly not university settings—that would rival us"

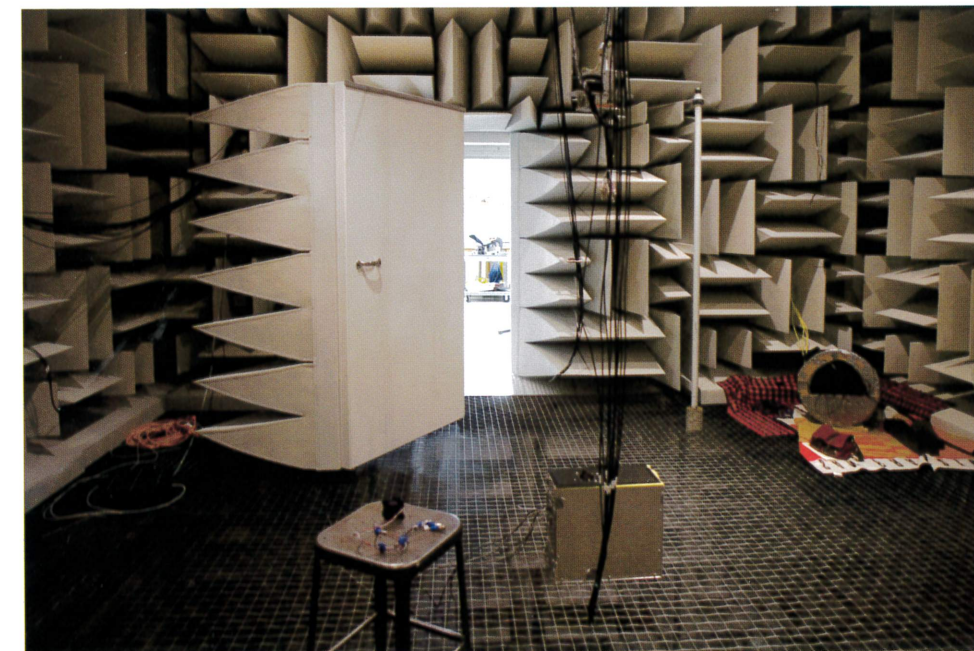
—Scott Sommerfeldt

look at bringing it up to modern standards." And so a few years ago work began on the process of building and remodeling. The result? BYU now has two anechoic chambers: one large, fully refurbished one and a smaller chamber with variable acoustical properties. In addition, a recent addition to a different lab furnishes BYU with two coupled reverberation chambers. The new facilities are now fully functional, and they are well used.

Thanks in large part to the facilities that assistant professor of physics Kent Gee calls "just exceptional," BYU has one of the nation's

largest undergraduate programs in acoustics. Here students can major in either physics or applied physics and then specialize in acoustics, one of the department's six research groups. Although acoustics is the smallest group in terms of faculty, it attracts 25 percent of all physics students. With anywhere from 10 to 20 undergraduate students and from eight to 10 graduate students, BYU's acoustics program distinguishes itself in size as well as academic achievement. "Many universities have acoustics taught only at the graduate level; BYU is unique in that students can focus on acoustics as part of their undergraduate education," Gee says. "The number of undergraduates that we have here and the mentoring that they're able to receive is truly remarkable."

And mentoring is a large part of what makes BYU's program exceptional. Professor Gee ought to know. He himself is a product of BYU's emphasis on the student-faculty relationship. Before he went to Penn State for his PhD, Kent Gee was one of Scott Sommerfeldt's graduate students at BYU. For Gee, mentoring gives him a decidedly personal satisfaction—a way to create relationships like the one that assisted him as a student. "I really enjoy working with students at the junior and senior level, because of what Scott Sommerfeldt was to me six years ago." He says. "It's very gratifying for me to turn around and work with these students—to help them get involved early on in research and see how they can become researchers themselves."



BYU's acoustics students appreciate and profit from this mentoring tradition—and with good reason. Due in large part to the hands-on experiences they have with faculty mentors, students excel in the program; and after they leave BYU many go on to study acoustics at the graduate level, either at BYU or elsewhere. Because the quality of BYU's students and facilities has increased over the last several years, the university's graduate program has become quite competitive.

Students are involved with professors' hands-on research in a number of ways. Tim Leishman, faculty leader of the Acoustics Research Group, has worked with students on several projects that have attracted particular attention from The Church of Jesus Christ of Latter-day Saints audience. One was troubleshooting the LDS Conference Center acoustics, and another was comprehensively surveying the Salt Lake Tabernacle acoustics prior to its renovation. Currently Dr. Leishman works with students on projects ranging from optimizing the varied characteristics of audio systems in cars, home theaters, and outdoor settings to developing new, improved methods for measuring auditorium acoustics. All of these projects, he says, "are great mentored learning experiences for the students."

After graduate school BYU students may take their research and training in a number of directions. Some work for acoustics consulting companies, which might involve architectural



projects or community noise issues, and some go into the audio industry. "Students have quite a range of places they can go," Sommerfeldt says, "but we find that employers are extremely happy with BYU graduates from the acoustics program. Almost all express interest in looking at our graduates in the future."

Because acoustics is a fairly interdisciplinary field, the BYU acoustics program is a major collaboration among several programs on campus. The Departments of Mechanical Engineering, Communication Disorders, and Electrical and Computer Engineering all share common goals with the acoustics program, benefiting students from all departments with shared resources and information. Says Sommerfeldt, "Because we make our facilities and equipment available to each other, we've really built a nice synergy."

This availability of resources, the interest of faculty members in student work, and the reputation that BYU students are making for themselves in academia and the professional world combine to make the acoustics program at BYU truly distinctive. And with the new reverberation and refurbished anechoic chambers, BYU has exceptional facilities to match its exceptional students. ■



Understanding the Path to Understanding Math

JANET WALTER AND HOPE GERSON TEACH AN HONORS CALCULUS CLASS THAT DOESN'T LOOK LIKE MANY INTRODUCTORY MATH CLASSES. For one thing, they don't lecture. They validate students' personal agency and facilitate their improvisational inquiries into mathematically challenging tasks. The students don't sit in rows—they sit facing each other in groups. And the students don't just answer questions from a textbook. Instead they work together to apply mathematical concepts to practical, real-world problems, and they often present their work to their professors and classmates.

This approach to mathematics education may sound innovative enough, but that's only the beginning. In every class session, undergraduate mentored students videotape the calculus students as they work. Not only do they set up, operate, and take down the professional-quality equipment, but they also learn to develop an eye for what to videotape. "From the perspective of a researcher you are in a position to be looking in detail at how students learn mathematics, and you gain a much deeper understanding for what learning mathematics is all about," says Dr. Gerson. These mentored math education majors are looking at student learning through the lens of prospec-

tive teachers. As they tape the class, they ask themselves, "How are these students learning calculus?"

That "how," Dr. Walter says, is the question that propels the calculus project she and Dr. Gerson have been running for three semesters. "We felt that, especially for our mathematics education majors, our students need to know how one comes to understand mathematics, not just what math is and how we use it." And so the professors teach an honors calculus class that aims to help students from a variety of majors think about mathematics in new ways.

For the calculus students, the class offers a dramatically different learning environment. The teachers are hands-off and let students talk together to solve problems using skills they bring from their varied experiences and majors. "Our philosophy about teaching is that if we give the students good, rich, open-response tasks to work on, which are accessible at an entry point, they have some tools with which they can at least begin thinking about the problem—and they are perfectly capable of developing math that's appropriate for the problem without our assistance," says Dr. Walter. These open-ended tasks, combined with the collaboration that defines the class, help students see

beyond formulas and applications to make sense of problem situations.

While this novel teaching process guides the calculus class, the undergraduate students that Drs. Gerson and Walter mentor as part of the project begin to look at mathematics education in a new light. "Telling students what to do is not an effective way for them to understand concepts," their teachers counsel. And so a research team that includes eight undergraduate mathematics education majors studies classroom interactions to devise new, more productive ways to teach. The team spends hours in class taping the sessions and then hours more pouring over videotapes, transcribing the conversations and analyzing students' mathematics learning.

Their mentors encourage the students to approach research in mathematics learning with specific questions. They find an element of the classroom interaction that's of interest to them and then pursue that question. Two mentored undergraduate students, Elizabeth Bunch and Tara Rosenlof, are already seeing how that research can shape new philosophies of mathematics education. "I love being in the classroom and watching students," Bunch says. "These students come in from all these different fields,

and they're not told how to solve a problem, so they pull in engineering and physics and they have complete freedom to solve the problem however they can—just like they would in the real world. And they do it!"

Bunch discovered her interest in teaching math through her love for theater. At her high school in Texas she helped fellow cast members comply with her school's "no pass, no play" policy, a rule that required students to pass their academic courses before participating in activities like athletics and theater. "I was amazed," she says. "I was helping people with their homework, and all of these very intelligent students could build beautiful two-story sets with perfect 90 degree angles but couldn't pass algebra, even after taking it three times." The experience suggested to Bunch a gap between the classroom and the real world. "I realized that a lot of teachers don't teach math so that students understand how they can use it in their lives everyday."

And so Bunch decided that she wanted to do just that—give students hands-on experience with mathematics and a sense of the accessibility to the principles and the appli-

cation of mathematics in daily life. When Dr. Gerson told her about the calculus project, she was interested. "I wanted to see if this really worked," she says. "I wanted to see this philosophy in action." She joined the project in its first semester, observing the calculus class and then formulating her own research question. She's interested in "socio-mathematical norms," or class structures such as small groups and collaboration, that aim to help students learn. Specifically, she's interested in whether or not these structural implementations work—whether the structure really changes what happens in the class and affects how students learn.

After she graduates Bunch hopes to combine her two loves. She plans to teach high school math and after school head up the technical side of a theater program. Actually, she sees some overlap between math and theater. "I'm seeing a lot of theatrical elements in these classroom interactions, with the roles of student and teacher and the way people act around each other."

Rosenlof appreciates addressing a question prompted by her own relationship to mathematics. "I used to hate math!" she says with a laugh. "But when I took college algebra at BYU-Idaho, I realized that if I worked really hard, I could do it. And then I started to like it." Once she identified part of her trouble with mathematics, she began to wonder if it affected other students in similar ways. "I think one of my problems with math in high school was that I didn't feel comfortable asking questions. I didn't want to look stupid."

Rosenlof believes if students do feel comfortable asking questions, they'll be able to learn mathematics. She considers questioning mathematics principles and concepts a choice and studies how this choice can affect the development of mathematical concepts in the students. As she pursues this research, she takes advantage of the inquiry-based classroom that Gerson and Walter have created. In most classes students expect the teacher to lecture, and the



For the calculus students, the class offers a dramatically different learning environment.

teacher expects the students to take notes. But in this class students can control the session with their questions and come up with surprising ways to think about mathematics.

Right now, Rosenlof is deciding whether she'll pursue an MA after her mathematics education degree or begin teaching school immediately. An MA would help her obtain a teaching position in her home state of California, but she's eager to get started. "I want to teach algebra in junior high," she says. "I love to see students who come in a little more timid in math suddenly realize that they can do it—that they're capable of it. They just have to be dedicated to it." Whether she leaves BYU to teach or to attend graduate school, she feels grateful for the chance she's had to understand the process of teaching and understanding mathematical concepts.

Says Walter, "We want them to envision a student-centered classroom where the teacher is not the teller but part of the learning experience." ■





Breathing Easy

ATMOSPHERIC CHEMISTRY AND STATISTICS

RIGHT AROUND MID-JANUARY AND INTO FEBRUARY, IT'S NOT UNCOMMON TO SEE A LAYER OF YELLOWISH HAZE HANGING JUST ABOVE UTAH COUNTY. For a group of students and teachers at BYU, that haze poses two interesting questions: What sources contributed to that pollution? And what is that smog doing to biological systems?

The pollution raises other questions, too, and Jaron Hansen, assistant professor in the Department of Chemistry and Biochemistry, and William Christensen, assistant professor of statistics at BYU, work with their students on a series of pollution-related issues. The students also collaborate with Arden Pope, of the Department of Economics, to gauge human response to particle pollution.

These aerosols (i.e., small particles suspended in the atmosphere) might seem too small to matter. After all, they're only 2.5 micrometers in diameter and smaller—a fraction of the size of a human hair. But in fact, Hansen says, "The smaller the particle, the deeper it travels into the body and the more damage it can do." He and Pope and their students are interested in exactly how *much* damage the particles can do. To this end, Roman Kuprov, a PhD candidate in analytical chemistry, studies the effect of fine-particle pollution on the human body's endothelial cells, the cells that line the inside

of blood vessels and control the vessels' auto dilatation and contraction. Other students may be observing this human response as well, but no one's studying it quite like Kuprov.

He, Dr. Hansen, and Dr. Delbert Eatough, another professor in the Department of Chemistry and Biochemistry, designed and built one of the few exposure chambers in the country to measure the effects of aerosols on endothelial function. The chamber sits in the Benson Building just below a smog chamber, a room large enough to accommodate a massive Teflon bag that Kuprov fills with synthetic air mimicking the air quality of Utah County. To generate levels and compositions of pollution similar to the ones that BYU students actually breathe, Kuprov and Hansen have arranged to burn the coal the BYU Power Plant routinely uses. They inject the smoke from the burning coal into the bag, then pump the air into the exposure chamber, a small room where BYU students volunteer to do homework, watch TV, or eat bagels and pizza while their bodies respond to these levels of pollution.

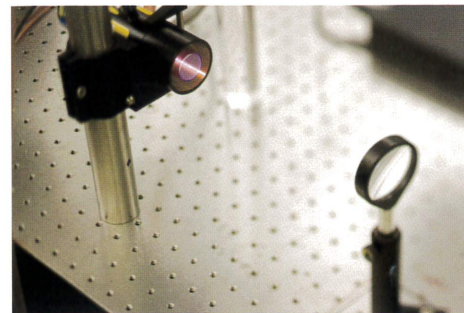
The exposure chamber—which is never filled with pollution levels greater than those seen in Utah County during inversions of the late 1980s—shows Kuprov just how the human body reacts to different levels of contamination. He measures his volunteers' endothelial

function before they sit in the chamber, after they've inhaled the pollution for three hours, and when their bodies have had time to cleanse themselves three hours later. Kuprov has found that the endothelial cells do become inflamed from the exposure, and the cells can't dilate and contract as easily. For someone prone to

The equipment lets students determine how the presence of water vapor in the air affects certain chemical reactions.

cardiovascular disease, Dr. Hansen says, "This is bad news, especially during these inversions when people are breathing in this junk for days and never reclaiming their endothelial function. They can be in pretty serious trouble."

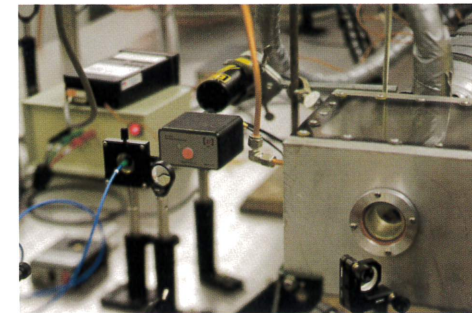
Hansen and his students, along with Arden Pope, publish their findings and drive policies that seek to curtail air pollution. This collaboration is one of the things that sets BYU apart for Kuprov, who calls the teamwork "gratifying."



"The Chemistry Department feels more like a good team than just a department," he says. "Everyone knows each other. There is a lot of collaboration between the faculty members and the students."

Alecia English also appreciates that collaborative environment. A master's student in analytical chemistry and a former student of Hansen's, English credits him with helping her find the project she is currently working on. "He knows a lot of people in the field," she says, "and he stays in touch. Fortunately for me as his student, he sent me to do research with some of his contacts at Ford Motor Company." Right now English is in Dearborn, Michigan, finishing her master's thesis. She's working with scientists at Ford to study the reactions of gas molecules after they are torn apart by a high-energy laser flash. She is familiar with the reaction, since, as she says, "BYU has the same type of system set up in the Benson Building." The equipment lets students like English, who are interested in gas-phase kinetics, determine how the presence of water vapor in the air affects certain chemical reactions.

Jared Clark, seeking a PhD in analytical chemistry, and Ryan Thalman, a chemistry major who expects to graduate in August, want to know how this water may "perturb," or shut down, the reactions that produce pollution. Specifically they're interested in the series of reactions that produce ozone, a molecule that can form photochemical smog or attack biological systems if it exists in the troposphere, the lowest layer of the atmosphere. Evidence suggests that water may bind to potentially harmful organic peroxy radicals to form highly reactive, loosely bound complexes. Once water reacts with the compounds, they may form molecules other than ozone, molecules that aren't harmful to biological systems. BYU students measure these reactions with a high-powered laser, which Hansen and his students constructed themselves.



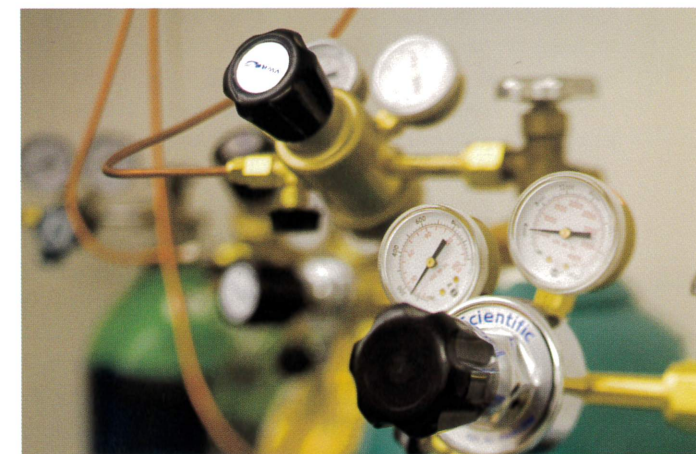
Thalman says he benefits immensely from this faculty-student relationship. "I've enjoyed the opportunity to interact with faculty on a personal basis and have been able to learn a lot more that way," he says. Dr. Hansen agrees that the interaction between professors and their students distinguishes BYU from any other program of its kind. "Such a level of trust exists here," he says. "We pair graduate students with undergraduate students and everyone works together. I oversee the whole thing, but when it comes to getting our hands dirty, everyone's involved."

And students are working on an impressive range of topics. Matthew Heaton, a master's student in statistics, and Basil Williams, an undergraduate majoring in mathematics and statistics, work with Dr. Christensen to identify and describe sources of air pollution. Christensen has already received wide attention for his work in this field. He's developed a statistical approach to determining sources of air pollution, even when a variety of pollutants make the chemical components of the "soup" difficult to distinguish. With Christensen's guidance, Heaton is developing a model that determines exactly how much pollution a source emits daily, accounting for what he calls "double pollutants," or pollution that hangs in the air for a few days and so may be ascribed to the same source multiple times.

Williams works with Dr. Christensen and Dr. Shane Reese of the Statistics Department on a similar project. "We're using meteorological data," he says, "together with pollution concentration measurements, to pinpoint locations of various pollution sources, such as factories or smelters." Like his fellow students working on questions of air pollution and human

response, Williams will use his research to increase awareness of air pollution and to curb the dangerous effects of fine particulate matter on human endothelial function.

In the academic sphere this research can go in a number of productive directions. Scott Morris, a major in the statistical science emphasis, has already seen the far-reaching effects of atmospheric chemistry on the earth's climate over time. Like Heaton and Williams, he works with William Christensen, but his project evaluates total global ice volumes and glacial periods by studying various concentrations of oxygen-16 and -18 isotopes. He and Christensen are comparing terrace levels above a streambed in Utah and correlating them with the oxygen-18 data, hoping to confirm the approximately 100,000-year Ice Age period. He plans to present his findings at BYU's Spring Research Conference and credits Dr. Christensen with guiding him



through this project. "I have been impressed with the concern and care the faculty members have for each student as an individual," Morris says.

Not only do students enjoy the faculty-student relationship at BYU but they also find it tremendously effective in creating scholars prepared for sophisticated academic and professional work. "We've had some huge success in mentoring these students," Dr. Hansen says. "The first undergraduate that we mentored has gone off to graduate school; another one just got into the UC-Berkeley graduate program." And if the variety and quality of work their students are doing now is any indication, Drs. Hansen and Christensen and their colleagues are just seeing the beginning. ■

FEATURED DONORS

David and Barbara Meyers

DAVID MEYERS LEFT HOME IN BOISE, IDAHO, IN 1982 BOUND FOR BYU AS AN EARLY HIGH SCHOOL GRADUATE. He had taken a FORTRAN course in high school and knew he liked programming, but he wasn't sure about a major. As he searched the BYU undergraduate catalog for a major that did not require chemistry, his eye landed on business, and that is where he started his collegiate career. A class in business computing rekindled Dave's earlier interest in computers and programming, and he changed his major to computer science.

Interrupting his formal education for education of a different sort, a mission for The Church of Jesus Christ of Latter-day Saints, Dave left for Taiwan in 1983. When he returned two years later, it was back to the books, the computer lab—and a fashion merchandising major named Barbara Nelson from his student ward. Dave got a job as a teaching assistant in the Computer Science 142 lab, working under the direction of Dan Johnson ("That was a great job!"), and often Barb would sit in the lab and do her homework while she waited for Dave to finish helping students. Other TAs advised him, "My wife wouldn't even consider sitting in a computer lab waiting for me. You had better marry that girl!" He followed their counsel.

Following graduation in 1986, Dave and Barb moved to Fort Worth, Texas, where Dave worked for General Dynamics, and then to Houston, where he was a computer engineer with an oil and gas pipeline company. After three years he took advantage of a program that allowed him to earn an MBA at Rice University while working full-time. The business degree, combined with the computer science degree

and work experience, created new opportunities for Dave. He began his own company, building software models of risk management in energy commodity trading. The company did so well that it was eventually bought out by a competitor, leaving Dave in the enviable position of being able to do what he wants to with his time, i.e., maintaining an active interest in various software systems, real estate, and other business enterprises.

As Dave thinks back on his educational experiences at BYU, he recognizes two things in particular. First, there were faculty members who were exceptionally helpful—who went to what seemed to him extra effort to help him succeed in the computer science program. Aurel Cornell stands out as one mentor who gave careful and helpful guidance, and so does Vern Crandall. Second, Dave did not realize until after leaving BYU that his exposure to important areas of computer science there had put him ahead of his peers from other educational institutions.

Dave sees that adding the MBA to his computer science degree was a good decision and

advises students today who are headed for careers in business and industry that technical knowledge and business skill combined make for a strong résumé. An employee needs to be of value to an organization to succeed, and understanding the organization (that is, knowing how the business works) is key to knowing how to most effectively apply technical knowledge. In a business organization it is not enough to know only how to manipulate computer software—one needs to have a vision of the effect that expertise will have on the operation of the business.

The Meyers have been giving to the BYU general fund for some time, but they have also recently donated a scholarship to the Department of Computer Science. Their generosity will bless many students for years into the future. When asked why he decided to endow a scholarship, Dave replies, "I'm just a 'plain old guy,' but BYU is a great institution. And actually, it was Barb's idea." We call that teamwork. Thanks to Dave and Barb Meyers for making a difference! ■



CLASS NOTES

National Recognition for Undergraduate Mentoring

Two recent awards for undergraduate mentoring, both from the National Science Foundation (NSF), underscore the prominent role mentoring plays in the College of Physical and Mathematical Sciences. One award, for nearly \$1.3 million, establishes the Center for Mentoring Undergraduate Research in Mathematics. Says Professor Michael Dorff, one of the faculty sponsors of the proposal, "Basically, this center will promote undergraduate research in mathematics by providing minigrants to about 15 mathematics professors at various institutions across the U.S. (including BYU) and about 45 undergraduate students working on research during the academic year. Also, the participating professors will visit BYU during the summer to be trained in doing undergraduate research, and the undergraduates will attend and present their research at an expanded BYU Spring Research Conference."

The second grant, for \$705,000, establishes the Information and Decision Algorithm Laboratories (IDeA Labs). This is an interdisciplinary program involving mathematics, statistics, and computer science students and faculty members. Its aim is to improve the preparation of undergraduates to pursue careers or graduate study in fields that require integrated strengths in computation and the mathematical sciences. The NSF evaluation said, "If successful, this program can serve as a national model for integrating teaching and research at the undergraduate level."

CS Undergrads Develop "Tour de Finance"

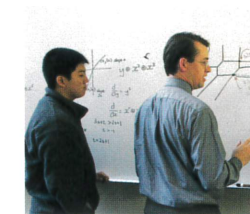
Casey Dougal, majoring in mathematics and economics, and David Merriman, a computer science major, will present "Tour de Finance" at the 2007 American Control Conference in New York City this summer. The work is an automated paper-trading system the two undergraduates developed during the course of their research with IDeA Labs (Information and Decision Algorithm Laboratories), cosponsored by the Department of Computer Science and the Department of Mathematics.

The system developed by Dougal and Merriman allows individuals to build "agents" that

can access real-time stock data on the NYSE and NASDAQ and then make trading decisions to grow a model portfolio. The "investor dynamics" design, which models the market for mutual funds, provides a way of transforming the question of portfolio management into one of controlling a dynamic software system to increase the investor's market share.

Dougal and Merriman conducted their research under Dr. Sean Warnick of the Department of Computer Science with the aid of donated undergraduate mentoring funds.

Math Senior Wins National Research Poster Session



The Mathematical Association of America recently selected Julian Tay, a senior mathematics major at BYU, as a winner of the association's

2007 National Undergraduate Student Poster Session. The contest took place January 5–8, 2007, in New Orleans during the Joint Meeting of the Mathematical Association of America and the American Mathematical Society. The poster, "Tropical Derivatives and Duality," was based on research Tay (left in photo) performed with the BYU Tropical Geometry and Algebra Group under the direction of Dr. Tyler Jarvis (center). As explained in the presentation, tropical geometry is a relatively new branch of mathematics that relates to many other fields of the broad discipline, such as combinatorics and algebraic geometry, and to other sciences such as biology (e.g., phylogenetics).

Geology Students Take a Volcano's Temperature

Greg Carling and Anne Dangerfield, both graduate students majoring in geology, presented reports on the measurement of lava temperatures in two presentations at the April 2007 European Geoscience Union meeting in Vienna. Supported by donated undergraduate mentoring funds, they began their research as undergraduates in August 2005 on Kilauea Volcano in Hawaii. The work involves evaluating the

viability and reliability of different methods for remote observation of active volcanoes. The students obtained temperatures using a consumer digital camcorder and compared those with MODIS satellite observations and with direct thermocouple measurements of the lava. Given that remote observations are becoming increasingly important for understanding the behavior of active volcanoes, Carling and Dangerfield have found it rewarding to be among the first researchers to successfully test the viability of consumer camcorders for this type of work. They are working with faculty members Jani Radebaugh, Jeffrey Keith, and David Tingey.

CS Student Pioneers in the Field of Virtual Photography

David Cline, a PhD candidate in computer science working under the direction of Dr. Parris Egbert, is pioneering in the field of global illumination or, as he likes to call it, "virtual photography." As the name implies, Cline's work allows animators, graphic artists, and computer scientists to create digital images that look astonishingly real, as if one had captured the scene with a camera rather than with bits and bytes. To create photorealistic scenes computer graphic artists have to integrate all



of the light that reaches each pixel contained in an image. With multiple rays of light hitting each pixel and thousands, or even hundreds of thousands, of pixels in an image, this quickly becomes an enormous task. Cline's work makes the process more efficient by using the information gleaned from the first pixel to improve the process for later pixels. This innovation dramatically reduces the amount of time needed to create photorealistic images, such as this image of a dragon.



EVERY STUDENT WHO LEAVES THE COLLEGE OF PHYSICAL AND MATHEMATICAL SCIENCES WITH AN UNDERGRADUATE MENTORED LEARNING EXPERIENCE IS BETTER PREPARED TO BLESS OTHERS AND HELP THE WORLD SOLVE ITS PROBLEMS. "Mentored learning" is what happens when a student works with a faculty member outside of class on research of consequence to them and to their scientific discipline. And it makes a difference! Says a typical mentored student, "Until you do these things in the lab yourself, you don't really know how to do them—even if you think you understand the ideas." Instead of finding needed employment off-campus, the mentored students do real-world research that will help prepare them for their professional lives. You, our alumni and friends, can help make this possible.

On Saturday morning, March 18, students and faculty filled the classrooms of the Martin Building on the BYU campus for the 21st Annual Spring Research Conference of the College of Physical and Mathematical Sciences. That day 324 students discussed the results of their mentored research in 15-minute presentations, modeled after a typical, professional

scientific conference, in over 20 concurrently running sessions. Some of these students will refine their work and present it at regional and national scientific meetings. Some will coauthor scientific publications with their mentors. All will look back and recognize how such experiences made a positive difference for them.

Our goal is to provide a mentored learning experience for every student in our college who wants to participate. This is, in fact, our top academic priority. Thanks to our alumni and friends, we are getting closer to that goal. At the Spring Research Conference we awarded 56 new "Frontiers Mentorships," funded entirely by your donations to the College Annual Fund. A group of the recipients gathered for a photo, above, during the morning break at the conference. I invite you to visit our college Web site (cpms.byu.edu) to learn more about how you can help students to have this experience, or to contact Brent Hall (1-800-525-8074 or brent_hall@byu.edu). Join with us in opening doors for students.

—Earl M. Woolley, Dean